

## Assessing the small ruminant value chain in arid regions: A case study of the North-Eastern Badia Basalt Plateau in Jordan

Rula Awad<sup>1</sup>, Aziza Mohamed-Brahmi<sup>2</sup>, Hosam Titi<sup>3</sup>, Mohamed Jaouad<sup>4</sup> and Aziza Gasmi-Boubaker<sup>1</sup>

<sup>1</sup>Department of Animal Production, National Agronomic Institute of Tunisia. Carthage University. Tunisia; <sup>2</sup>LR14AGR04: Support for the Sustainability of Agricultural Production Systems in the North West Region, Ecole Supérieure d'Agriculture du Kef (ESAK), Tunisia University of Jendouba. Route Boulifa, 7119, LeKef. Tunisia; <sup>3</sup>Faculty of Agriculture, University of Jordan. Jordan; <sup>4</sup>Institute of Arid Regions Medenine, Laboratory of Economy and Rural Societies. Route du Djorf Km 22.5 Medenine. Tunisia.

\*Corresponding author's e-mail: [rula.a.awad@gmail.com](mailto:rula.a.awad@gmail.com)

This study aims to analyze the small ruminant value chain in the North-Eastern Badia region of Jordan, which is a significant source of income for local farmers. The objectives include characterizing the value chain, identifying stakeholders and their roles, and addressing the challenges it faces for long-term sustainability. Primary data was collected through a structured survey from 80 small ruminant holders in the district. The survey covered various aspects such as input supplies, husbandry practices, processing, marketing, and consumption. Additionally, individual interviews were conducted to analyze the value chain. The findings revealed a diverse range of actors involved in the value chain, including input suppliers, producers, animal collectors, traders, processors, and consumers. The SWOT analysis highlighted key issues such as high feed costs, limited and arid rangelands, inadequate government services, and unstable decisions. Moreover, neighboring small ruminant holders near Syrian refugee camps faced challenges related to land pollution caused by the refugees. In conclusion, besides to the negative impact of the climate change on the farms management due, particularly, to the consecutive drought years, the small ruminant value chain in the study area lacks organization and is not sufficiently supported by the governmental and non-governmental entities, and the Syrian refugees' situation.

**Keywords:** Small ruminant, Value chain, Sustainability, SWOT analysis, Jordan, North-Eastern Badia Basalt Plateau.

### INTRODUCTION

Generally, sheep and goats flocks are reared on grazing land in relatively large groups relying on low inputs in terms of feed, water and labor, and possess high thermos-tolerance compared to large ruminants such as cattle and are critical for food security and livelihood, especially under extreme stressful and diverse climatic environments (Joy *et al.*, 2020) particularly in the arid and semi-arid regions where this sector undertakes a significant role (Berihulay *et al.*, 2019). Small ruminants are particularly well-suited to these regions because they are adapted to harsh, dry conditions and can subsist on low-quality feed (Kumar and Roy, 2013). Their role in these areas extends beyond basic substance. In Jordan, pastoral livestock production is mainly located in the Badia (Abu-Zanat, *et al.*, 2005). Numbers of sheep and goats raised in the North-Eastern Badia Basalt Plateau of Jordan at the end of 2021 were around 304,242 and 31,777 heads respectively, distributed among 2,599 farmers (MOA, 2021). These animals make up

26.2% of the entire small ruminant flocks in Jordan, which were approximately 3.95 million heads (MOA, 2021). However, despite adaptive traits that enable these animals to thrive in arid and semi-arid environments, the increased temperatures and declining amounts of precipitation associated with other climate change impacts in Jordan have amplified the limiting factors of small ruminant productivity there (Al-Khaza'leh *et al.*, 2020).

Value chains provide a clear understanding of the actors, activities, services, opportunities and challenges related to the flow of specific products of small ruminants and associated services, from input suppliers and farmers to final buyers/consumers (Alary *et al.*, 2009; Duguma *et al.*, 2012; Shah *et al.*, 2015a). Value chains are also used as a structured tool for evaluating potential development interventions (Gebregziabhear, 2018). In arid and semi-arid regions, small ruminant value chains face specific challenges due to the harsh environmental conditions and limited resources (Katiku *et al.*, 2013) such as limited access to water (Amankwah *et al.*, 2012); Scarcity of forage (Duguma *et al.*, 2012); disease and health issues (Desalegn, 2020); limited

Awad, R., A.M. Brahmi, H. Titi, M. Jaouad and A.G. Boubaker. 2023. Assessing the small ruminant value chain in arid regions: A case study of the North-Eastern Badia Basalt Plateau in Jordan. *Journal of Global Innovations in Agricultural Sciences* 11:549-560.

[Received 10 Oct 2023; Accepted 10 Dec 2023; Published 22 Dec 2023]



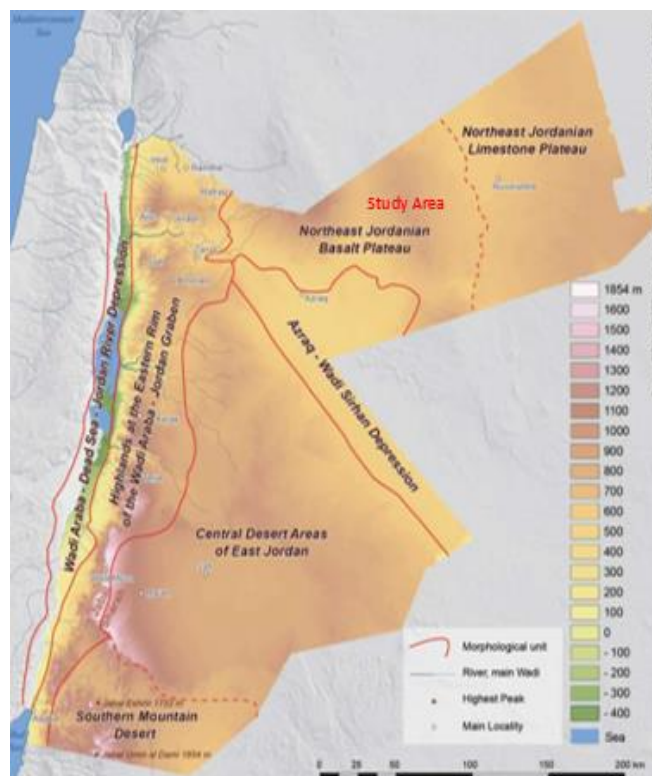
Attribution 4.0 International (CC BY 4.0)

market opportunities (Gebregziabhear, 2018); and climate change impacts (Sejien *et al.*, 2013). These changes can further exacerbate the challenges faced by small ruminant value chains, affecting their productivity and sustainability.

Existing knowledge about the small ruminant market structure, channels/ports, behaviour, performance, and price formulation in the study area is considered weak. To the best of our knowledge, information on previous studies in this field are almost non-existent. Accordingly, this study is important to assess the stability of the small ruminant sector in the study area. The main objective of this work is to study and document the small ruminants' value chain in the North-Eastern Badia Basalt Plateau of Jordan through presenting a clear description of the stakeholders and their role within the chain to identify potential options for intervention, in order to enhance its efficiency and ensure its effective sustainability.

## MATERIALS AND METHODS

**Study Area:** The study was carried out in the North-Eastern Badia district located at the eastern part of Mafrq Governorate of Jordan ( $32^{\circ} 19' 47''$  N,  $36^{\circ} 30' 4''$  E), bounded by Syria to the north and Saudi Arabia to the south (Fig 1). The total area of the north-eastern Badia is about 11,200 km<sup>2</sup> (Scott and Dunstone, 2000; Ibrahim *et al.*, 2001), and the highest area is Umm al-Quttayn with approximately 1,048 m above sea level. The study area characterized by low, gently undulating topography relief that covered with basalt boulders of varying size and shape (Allison *et al.*, 2000). The region is predominantly inhabited by local Bedouins, and Syrian refugees living in host communities and camps, in particular the Al-Zaatari camp (Al-Khaza'leh, *et al.*, 2020). With an arid climate and frequent droughts cycles, The north-eastern Badia receives a total annual rainfall of about 116 mm (Al-Khaza'leh, *et al.*, 2020; Salahat and Al-Qinna, 2015). Water and pasture biomass availability in the region is limited and water quality commonly deteriorates due to agriculture and domestic runoff, and the consistent overuse of groundwater, which leads to increased salinity levels (Al-Khaza'leh, *et al.*, 2020). The livestock population in the study area is estimated to be about 304,242 head of sheep, 31,777 head of goats, 5000 head of cattle, and 3000 head of camels (MoA, 2021). The study area was selected due to its arid climatic condition and quality limitations faced by small ruminants' production.



**Figure 1. Location map of North-Eastern Badia, Jordan.**

**Material and Methods:** Differentiation advantage was adapted for small ruminant value chain analysis (MKSP, 2016), where the chain activities are identified and the role of the actors in these activities is described in order to be able to identify potential options for intervention. The results reported in this study are mostly based on the primary data gathered from different potential stakeholders in the value chain during 2021. Due to the clear geographical and social homogeneity of the study area (Shwaqfeh, 2006) and the difficulty of reaching potential actors in the chain, a survey was carried out on 80 small ruminant holders according to the sampling method proposed by Khader (2013). The north-eastern Badia small ruminant holders were randomly selected to simple random sampling procedure along the district after assign a unique identifier to each small ruminant holder in the target population and use a random number generator to select the required number of participants. A structured survey focused on the main aspects of small ruminant's production as input supplies, husbandry practices, processing, marketing and consumption was prepared. Individual interviews with the other potential stakeholders in the chain were used to carry small ruminants value chain analysis which included five (05) health care suppliers, a governmental services provider (01), fifteen (15) traders and ten (10) meat and milk processors. The data was conducted using IBM SPSS Statistics (Version 27) where it was analyzed using thematic analysis approach.

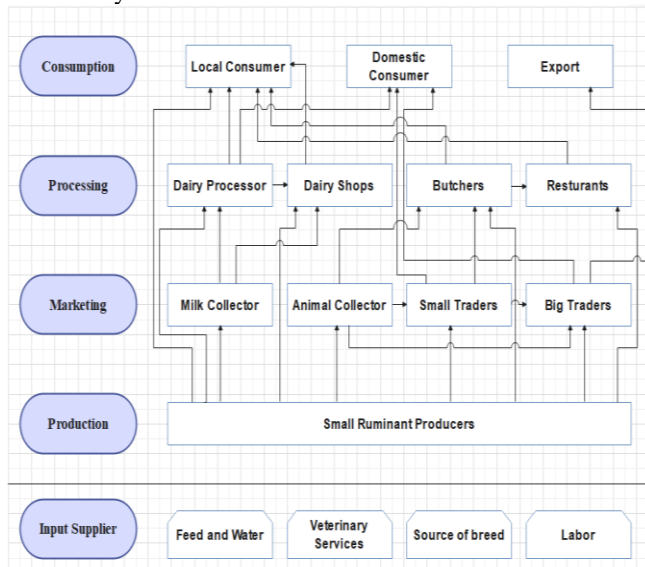


Quantitative data were analyzed using descriptive statical techniques. SWOT Framework within main Strength, Weakness, Opportunities and Threats of small ruminants' value chain in the study area was used to identify the opportunities and threats related to small ruminants' value chain in the study area.

## RESULTS AND DISCUSSION

### *Mapping core function and actors of sheep and goats value chain:*

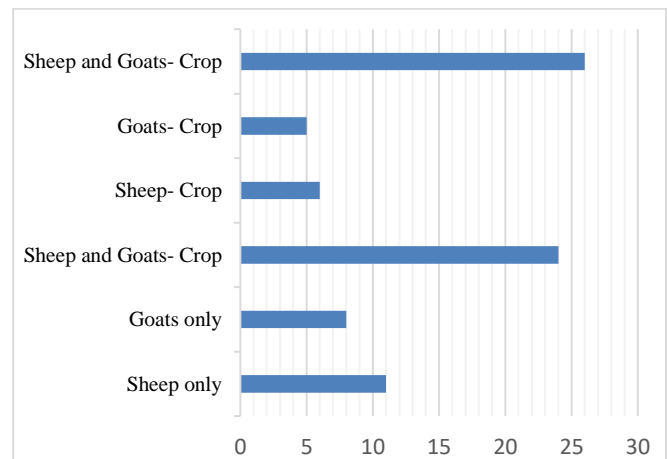
The small ruminant value chain in the North-Eastern Badia district consists of five core functions (input supply, production, marketing, processing, and product marketing and consumption) were analyzed within the input-output structure (Shah *et al.* 2015a; Chakraborty and Gupta 2017). These elements are represented by a set of value chain boxes linked by arrows showing the flow of products and services (Dugma *et al.*, 2012). Figure 2 shows the activities and actors across the five components of the small ruminant value chain in the study area.



**Figure 2. Small ruminants' value chain in North-Eastern Badia District, Jordan**

**1-Input supply:** Input supply for small ruminants' production includes: material inputs (source of breeds, feeds, vaccine and medications) and services inputs (credit services, capacity building services, animal health services and labor) (Shah *et al.*, 2015a). In the study area, the input supply were: breed, feed and water supply, labor and veterinary services. This converges to the critical inputs required for meat and dairy production of small ruminant in Liberia that included: animals, feed, water, and veterinary medicines/vaccines (Touray, 2017).

**1.1. Breeds:** About 83.75% of small ruminant holders raise Awassi sheep breed, the most common breed in the east of the Mediterranean that have adopted to arid conditions and low rain (AlNajjar *et al.*, 2021). Moreover, about 62.5% of them keep a small number of goats beside their sheep, while 16.25% of them rise only goats (Fig. 3). The dominant goat breed is Baladi goat representing 98.41% of goat population. The limited percentage of rearing only goats in the study area is possibly due to the climate, nature of the desert region and the lack of shrubs and browse vegetation suitable for the production of goats (Katiku, *et al.*, 2013). Generally, the source of animals in breeds was their original flocks. Farmers usually (95% of them) adopt sustainability out of stock to replace their herds matches the situations adopted by small ruminant producers in Lebanon (MercyCrops, 2014; Hosri *et al.*, 2016), northeastern Syria (Care and IMMAP, 2018) and Bahawalpur district/ Pakistan (Shah *et al.*, 2015b). The small ruminant species are shown in Fig. 4 and Fig 5.



**Figure 3. Small ruminant production in North-Eastern Badia, Jordan.**



**Figure 4. Awassi sheep in the study area.**







**Figure 5. Baladi goats in the study area**

**Feed and water supply:** Farmers in the study area feed their flocks subsidized feed mainly; barley and wheat bran according to the protocol and at prices offered by the Jordanian Ministry of Agriculture. According to this protocol, the amount of subsidized feed sold to each farmer covers 90% of the holdings of sheep and goats at a level of 20 kg/ head/ month of barley, while the amount of bran varies based on the Kingdom's production of wheat bran reaches 500 g/month/ head in good season and decreases to 250 g/ month/ head (MOA, 2021). A ton of subsidized barley is sold at (247) USD compared to (335) USD for the unsubsidized at the local market. Meanwhile, a ton of the subsidized wheat bran is sold at (108.5) USD compared to (220) USD for the unsubsidized. As that, the ministry of Agriculture is reducing the quantity offered by the subsidy policy by 20 % in order to get rid of factious holdings and the sheep holders, if one of them, has to submit an objection to verify his holdings. According to farmers, this constitutes a financial burden during the verification period mainly in the pregnancy and lactation physiological stages.

In northeastern Syria, small ruminant producers face similar problem during the season of pasture shortage, as many of them were forced to reduce the quantities of daily feed provided to their animals, in light of their limited financial ability (Care and IMMAP, 2018).

Crop cultivation, mainly barley is common for 46.25% of small ruminant holders. More than 90% of them rent lands to grow crops or rent already cultivated plots. The price of land rent depends on nature and location of these lands. All the farmers (100%) who cultivated barley area in the study zone reported that the cultivation failed during the past years due to long drought seasons. It should be noted that 33% of them mentioned that rent prices have increased significantly after the Syrian crisis. Results also revealed that more than 50% of framers within the study area move from one zone to another to look for water source for their animals, while the others are

forced to transport water using water tanks, or residence permanently next to water sources.

**Animal health and veterinary services:** The presence of veterinarian extensions is one of the keys to the successful improvement of the livestock sector, especially for small ruminants (Namonje-Kapembwa *et al.*, 2019). In Jordan, the Ministry of Agriculture is responsible for animal health services and the governorate of veterinary directorates provide free veterinary services, including vaccinations of FMD, PPR, Sheep and goats' pox, Brucellosis and Anthrax (Braam, 2022). This is also the case in Chakwal district of Pakistan, where vaccination is the main service provided by the public sector to farmers (Shah *et al.*, 2015a). Meanwhile, in the Beitbridge District of Zimbabwe, the supply of veterinary medicines consisted of both the State Veterinary Department and private companies providing animal health products and providing animal health related services to clients (Dube *et al.*, 2017).

Northern Badia Agriculture Directorate is the governmental side responsible for providing veterinary services in the study area. Also, there is a veterinary clinic in A-Safawi, that belongs to the Ministry of Agriculture which serves A-Safawi and Dair Al-Kahf sub-districts. However, as shown in table 1, there is a shortage in veterinarian staff in this Agriculture Directorate and its clinic, as there are only two veterinarians, an agricultural engineer and 5 veterinary nurses' men. It is noted that, the small ruminant holders who stayed on eastern desert get animal health services from Al-Azraq directorate due to their remoteness of governmental health service providers in the north- eastern Badia. As for the private sector which is represented by veterinary pharmacies, which present in somewhat sufficient number and activity, especially in the central and northern regions of the district. These pharmacies provide the necessary veterinary advices to small ruminant's owners and/ or diagnoses the disease and give appropriate treatment. As mentioned above, the directorates of agriculture provide the compulsory vaccines free of charge. However, 31% of framers were forced to buy these vaccines at their own expense due to non- permanent availability in the directorate's warehouse. All farmers are also forced to buy medications at their own expense despite their high prices constituting a complaint source.

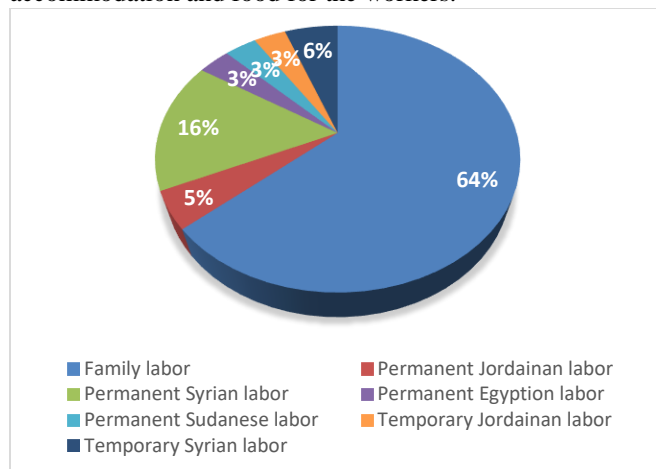
**Table 1. Governmental Veterinary Service Providers in North-Eastern Badia (MoA, 2021).**

Veterinary services staff	Al-Badia Ashamalieh agriculture directorate	Veterinary clinic in A-Safawi
Veterinarian	1	1
Animal production engineer	1	0
Veterinary Nurse	2	3
Agricultural worker	0	0



**Financial services and capacity building services:** If the required guarantees are available, the financing services are available through the Agricultural Credit Cooperation (Governmental Agency). Less than 10% of the surveyed farmers get loans from this Agency. Generally, surveyed breeders in north-eastern Badia do not access to capacity building services as there is no any such activity from governmental or non- governmental institutions with the exception of a breeder who was trained from a non-governmental organization project. According to Kassahun et al. (2020), using credit service significantly and positively affects market participation and level of participation in the small ruminant market, as it can be argued that those farmers who have access to formal credit are more likely to participate in the small ruminant market than those who do not have access to formal credits. In the absence of formal and specific credit services for sheep and goat production, funding sources can be through some NGOs (like National Rural Support Programme) used to provide credit to small ruminant farmers (Shah et al., 2015a), rural microfinance institutions, family asset building programs and rural savings and credit associations (Legese et al., 2014), or from informal intermediaries whose upfront financing is characterized by exorbitant interest rates (Touray, 2017).

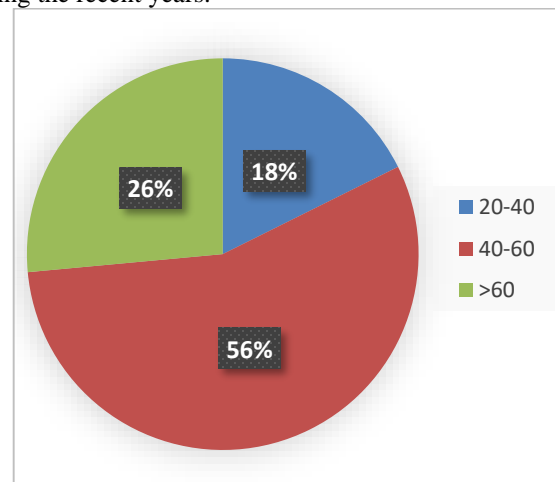
**Labor:** Family employment is prevalent in the study area as shown in Fig 6 and this situation is somewhat similar to many countries. For example, Low-input pastoral systems in marginal arid regions of Mali (ILRI et al., 2011) depend on family labor and so is it in Northeast of Syria (Care and IIMAP, 2018). Only 5% of the paid local labor in the study area and 35% of small ruminant holders surveyed employ foreign workers. Paid labor, which account the most prominent appearance, are Syrian labor. Only 10% of small ruminant holder surveyed employed workers temporarily. The average salary was (575) USD, in addition to providing accommodation and food for the workers.



**Figure 6. Small ruminant labor in North-Eastern Badia of Jordan.**

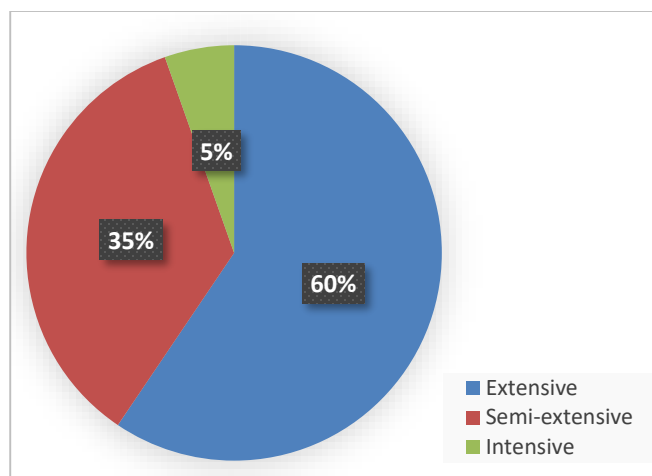
### Production (Management)

**Producers and small ruminant production systems:** In north-eastern Badia, small ruminant farming is totally family tradition for subsistence. It is the main source of income for 78.78% of the study sample and the only source of income for 53.85% of them. Middle age (20-40 years) is the most common among the producers, with 26.47 % of them over the age of 60 and 17.65% of them under the age of 40 (Fig 7). Over 43% of small ruminant producers who underwent the study are illiterate, 54% are at high school level (Tawjhi) and less, and only 2.7% of them are at higher education. Sheep and goat producers who were included randomly in the study can be divided according to the number of holdings into 3 groups: 1- Large holder producers (holding 500 heads or more) with 28.89%; 2- Medium holder producers (100-499 heads) with 35.56%, and 3- Smallholder producers (less than 100) with 35.56%. Major holdings (83%) were generally concentrated in the eastern region of the district represented by the eastern desert devoid of residential communities, while holdings varied in the northern region with residential communities. The study area is characterized by an extensive production system (59.5%), while only 5% used the intensive production system (Fig 8). Most producers feed their animals barley and wheat bran twice daily throughout the year, while about 67% of the herders move regularly with their flocks searching for water sources compared to 16% who doesn't follow a pattern in their movement. These results are similar to previous findings on the Jordanian Badia in term of the dominance of extensive production system (Juniedi and Abu-Zanat, 1993; Abu-Zanat et al., 2005). Abu-Zanat et al. (2005) mentioned that 59.2% of the farmers adopt transhumance system in Middle Badia of Jordan. All visited producers confirmed that the rangeland has been completely dried up during the recent years.



**Figure 7. Small ruminant producers' age/ year in the study area.**





**Figure 8. Small ruminants' production system in the study area.**

**Housing:** Open areas and temporary structures are commonly used for keeping small ruminants in the study area (Fig 9.a). Only 17.6% of them used closed sheds for keeping their animals (Fig 9.b). Providing a suitable housing system is probably the most effective way to protect small ruminants from adverse weather (Wadhwani *et al.*, 2016). Shah *et al.* (2015a) stated that adequate housing is important for better care, as well as improved productivity. In Bahawalpur region of Pakistan with semi-desert, livestock are not protected against cold in winter and heat in summer and small ruminants were commonly kept in open areas, tree shades, shrubs and temporary structures (Shah *et al.*, 2015b).



**Figure 9a. Small ruminants housing in the study zone (open area).**



**Figure 9b. Small ruminants housing in the study zone (closed sheds).**

**Breeding and reproduction:** Small ruminant breeding was entirely natural in the study area which is similar to many arid and semiarid regions as Bahawalpur district of Pakistan, Lebanon and UAE (Shah *et al.*, 2015b; Hosri *et al.*, 2016; Tabbaa *et al.*, 2018). Most stakeholders were not able to accurately determine the fertility rate due to the integration of males within females all the time. Despite the fact that herders' lack of sufficient skills, about 23.53% of them used sponges to improve production and to expedite the time of birth, to match the season of selling animals abroad and to get higher prices. Sponges are inserted by the herders themselves. Nevertheless, some authors indicate that same regions, better performances are achieved in traditional systems where breeding is uncontrolled (Wilson, 1989).

**Animal health care:** Although 75% of the surveyed breeders think that the regular vaccination is important, only 58% of them follow a vaccination calendar and regularly vaccinate their herds. Several diseases were reported in small ruminants in the study area with ovine rinderpest which commonly known as 'Peste des Petits Ruminants' (PPR) was reported as the major disease. Other diseases like Brucellosis, Mastitis, FMD, Sheep and goats' pox, and Diarrhea, were also reported. These are close to the diseases that were monitored in Northern Jordan by Al-Assaf (2012). Animal health services providers have agreed with farmers that veterinary services for small ruminants are financial burden on the breeders and insufficient.

**Dairy production and sheering:** It was difficult to determine the quantities of milk produced, as farmers do not have records or calculate the production amounts. In addition, they are not interested in knowing profitability. Only 37.5% of the small ruminant producers who surveyed cared about milk





production in addition to the number of gestations. Milk is produced either for in-house consumption or sold to dairy processor. Feed shortage led to use of milk mainly for lambs and kids (Shah *et al.*, 2015a). All goats' holders mentioned that goats' milk is not desirable to dairy processors buy so it is produced almost for in-house consumption. The herders sold milk for dairy processor indoor at an average price of (0.99) USD/L.

In the eastern part of the north-eastern Badia, small ruminant dairy processors come from outside the district during the season of milk production (after mid-November to the end of March) and temporarily set up mobile tents between farmers for milk processing mainly white cheese (Fig 10). It is of great interest that those dairy processors are not licensed and not subjected to health control in their products with minimal use of hygiene and food safety standards. Meanwhile, in the north sub-districts of the study area, small ruminant dairy processor collected the milk once daily and transported in non-refrigerated pickup to mainly Al-Khaldyia sub-district or for local dairy shop.



Figure 10. Temporarily mobile tents for milk processing.

Sheering is done once a year in spring and the majority sheer the sheep by themselves. However, 33% of the farmers pay (1.41) USD/head for sheering which is considered an additional non- profit cost. Most farmers are troubled by how to get over sheering waste, where some of them resorted to burn it. Wool production is uncommon in the study area with no one buying wool there.

**Marketing:** Marketing includes all the activities necessary to move the products from producers to consumers (Hussen *et al.*, 2013). According to responses of stakeholders in the study area, sheep market is generally oriented for export. Most of small ruminant producers in study area sell their animals to meet cash demand. In general, animal collectors and small traders directly collect lambs indoor from the eastern district (Fig 11), using large trucks to transport these animals to their distribution places. Though it is not common for them to go

to live animal market to sell their animals. However, 83% of small ruminant producers in eastern part went to informal live animal markets (Al-Mnarah market) or to Mafraq formal live market. There is a formal live animal market in study area but most of farmer went to informal market where a fee is required to use it. The farmers meet daily at early morning in a known and empty area to sell their animals there. The market has no infrastructure, and trading in the market follow supply and demand. According to herders, supply and demand are closely related to the Gulf markets. As revealed by 26% of the interviewed traders, they buy weaned lambs and then raise them in private farms for exporting (Fig 12). Male lambs are exported to the Gulf at age of 8 months, while females are sold inside domestic markets. Interviewed traders mentioned that the profit margin is (28.20 – 42.30) USD/head. It was reported that traders from the Gulf come to the district and collect sheep to export them to their country after giving them the necessary vaccinations.



Figure 11. Collecting lambs indoor by animal collector in the east of North-Eastern Badia.

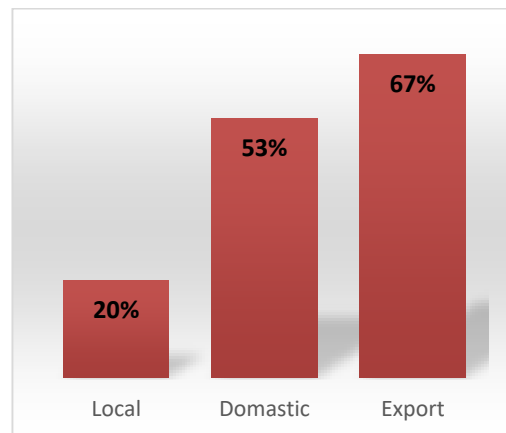


Figure 12. Sheep market in the study area.

**Processing:** Processing is one of the main functions of the small ruminant value chain (Shah *et al.*, 2015a). As mentioned above, minority (37.5%) produce dairy products



for home consumption or by outside dairy processors (Fig 13, Fig 14). Meat processing is carried out mainly by local butchers, restaurants located in that area, and/or consumers themselves. Restaurants in the area serve dishes based on sheep meat only, as goat meat is not desirable in the study area. The butchers sell raw meat as whole carcass or as cuts at a price of (14.10) USD/Kg, while the edible internal organs are sold at (8.46) USD/Kg. The restaurants and the butchers are subject to the supervision of the Jordanian Ministry of Health to ensure food safety. In Chakwal district of Pakistan, the processing and slaughtering of the small ruminants is carried out in recognized slaughterhouses at the level district then the carcasses were transported to the retail shops without any proper hygienic and safety protocols which concurs with what was reported by (Shah *et al.*, 2015a).



**Figure 13. Making white cheese in the study area.**



**Figure 14. Proceeded white cheese in the study area.**

**Consumption:** Mostly, the local community depends on homemade dairy products and/or the dairy products that are sold in near dairy shops. Up to 90% of the study sample stated that they desire sheep dairy products. Most of dairy products

are consumed by domestic consumers, where 83% of dairy processors market their products in the capital. Local meat consumers, that are mostly also producers, consume just Awassi meat. It is customary within the study area, according to the stakeholders, that ewes are consumed locally, while lambs are left for export. The demand for sheep increases before holly occasions like Eid Al- Adha, and they are sold outside the study area. The demand for sheep had also increased prior these occasions in Pakistan and Indonesia (Shah *et al.*, 2015a; Ibrahim *et al.*, 2019).

**Impact of climate change on small ruminant value chain in North-Eastern Badia District:** Environmental issues are particularly important in the small ruminant value chain, due to the dependence of this kind of farming on open grazing and the feeding of bulk feed material (CNFA, 2016). The lack of forage resulting from the scarcity and unpredictability of precipitations (& over grazing), along with prolonged droughts, has a negative impact on the production of small ruminants (Shah *et al.*, 2015b). According to Sejen *et al.* (2013) climate change affects seriously the availability of pastures during the period of recurrent droughts in production regions. In addition, severe climatic changes would impose various pressures on animals, which will negatively affect their production and reproduction (Sahoo *et al.*, 2013).

In north-eastern Badia, all the herders (100%) that are included in this study, reported that temperatures had increased in the long term, noticed a negative variation in rainfall rates and confirmed that the available rangelands were affected negatively. The climatic conditions prevailed in the study area, such as the decrease in precipitation rates, was one of the most important reasons of this deterioration in the rangelands from the point of view of them. Up to 96.25% of the breeders confirmed that they suffer from high costs in response to these climatic changes, as they were forced to rely completely on high-priced feed.

**Impact of Syrian asylum on small ruminant value chain in North-Eastern Badia district:** The Northern Badia region of Jordan is affected by many factors due to the influx of Syrian refugees into the region (Al-Khaza'leh, *et al.*, 2020). The presence of Syrian refugees in the area increased competition with host communities for resources and produced negative economic, social and environmental impacts, namely: higher food and commodity prices, increased food insecurity, lower local wage rates, and increased environmental degradation due to high pressure on biomass to meet energy and construction needs, as well as limited livelihood opportunities among others (Ilukor *et al.*, 2020).

The results of this study showed that the negative impact of Syrian asylum was more evident in the north and center of the study area than in the east; as the Syrian refugee camps were concentrated in those areas. Moreover, 67% of the small ruminant holders in the study area reported that the presence of the Syrian refugees led to increase the feed prices, increased the land of crop activity rent price, selling animals in the live





market at a price lower than its real cost price. They competed with the Jordanian holders in raising small ruminants, also as workers in the present vegetable crop farms at lower wage than Jordanian's workers who used these farms' wastes to feed their herds. Syrian refugees receive fund support from UNHCR with no living expenses (live in camps). Moreover, their interest is to have some cash to sustain life and their daily needs. Therefore, they can trade their animal at lower prices. The breeders of Umm Al-Jimjal, Umm-Quttain and Sabha sub-districts complained also from the pollution of the rangelands by the waste of Syrian refugee camps. On the other hand, 22% of the small ruminant holders who were surveyed reported that the presence of Syrian refugees had a positive impact on the issue of the availability of labor.

**SWOT Analysis for Small Ruminants value chain in North-Eastern Badia District:** SWOT analysis is an analytical approach used to discover the best match of internal resources, capabilities, and key competencies to develop competitive advantages and identify the limitations facing the analyzed sector, so it helps planners to identify factors associated with external opportunities and threats with internal strengths and weaknesses (Istaitih and Mencet Yelboga, 2018). SWOT Framework within main Strength, Weakness, Opportunities and Threats of small ruminants' value chain in the study area is shown in Table 3. The analysis revealed that the major constraints facing this chain are high costs of feed, scarcity and dryness of rangelands, weakness of governmental provided services and instability of governmental decisions. Furthermore, neighboring small ruminant holders to the Syrian refugees' camps have suffered from land pollution by the refugees' camps' waste. Nevertheless, despite these limitations, there are still opportunities to improve the chain. The potential interventions along the chain as solutions to those challenges are:

1. **Emergency response plan** by the concerned authorities to mitigate the effect of climate change; such as activating the Environmental Compensation Fund. And could include increasing the amount of barley and wheat bran subsidized to farmers to cover the needs of animals during drought periods.
2. **Capacity building of farmers:** by establishing specialized extension centers or activating government agricultural extension within Ruwaished Agriculture Directorate.
3. **Qualifying the young workforce** in the fields related to production and marketing
4. **Establishment of agricultural cooperative societies**
5. **Standing on the negative impacts of the presence of the Syrian refugees** in the study area and finding solutions that guarantee the suitability of small Jordanian holders, such as organizing Syrian work in this sector and organizing their presence in the rangelands.
6. Directing NGOs projects and support for small ruminant sector in the study area.

**Table 3. SWOT framework within main Strength, Weakness, Opportunities and Threats of small ruminants' value chain in North-Eastern Badia district- Jordan.**

Strengths	Weakness
<b>S1.</b> The governorate has tax exemptions on investment projects in which it is held may reach 75% for a period of ten years.	<b>W1.</b> Shortage of inputs and weakness in the production managements and marketing
<b>S2.</b> Market availability of small ruminants' products	<b>W2.</b> Low education level of sheep and goats' farmers
<b>S3.</b> Proximity to the foreign market which reduces the burden of export.	<b>W3.</b> Absence of appropriate infrastructure
<b>S4.</b> Small ruminant is the main sources of livelihood for farmers, and the this ensures the sustainability of the sector despite the challenges.	<b>W4.</b> Lack of access to credits
<b>S5.</b> Small ruminants sector working with full family team work.	<b>W5.</b> Weakness in government services and absence of non-government services
<b>S6.</b> Availability of labor especially Syrian labor	<b>W6.</b> Destruction of the pastures due to the increase of the number of Syrian refugees
Opportunities	Threats
<b>O1.</b> Increasing demand for dairy products from small ruminant in light of high prices of manufactured dairy products	<b>T1.</b> Study area Geography
<b>Q2.</b> Small Ruminants as a tool to alleviate poverty	<b>T2.</b> Unfavorable weather conditions
<b>Q3.</b> Marketing of small ruminants' products could be organized	<b>T3.</b> Unexpected rising of input costs
<b>Q4.</b> Exploitation of the abundant production of sheep and using brand system	<b>T4.</b> Political situation of neighboring countries.
<b>Q5.</b> Self-employment and entrepreneurship development	<b>T5.</b> Lack of qualified resources
	<b>T6.</b> Unfavorable government policy

**Conclusion:** This study was conducted in order to characterize the small ruminant value chain, to map out its stakeholders and their roles, and to identify the challenges facing it in order to guarantee its sustainability in the case of the North-Eastern Badia Basalt Plateau of Jordan. It can be concluded that the small ruminants' value chain in the study area is not well structured and the functions of the different actors in this value chain are not clear. It was also concluded that the small ruminant value chain was negatively affected by the climate change and especially the successive drought years, syrian Asylum, lack of input supplies, weakness of small ruminant value chain stages with clear and real absence of the governmental and non-governmental support for activities of the chain. Thus, there is a need to consider the



weakness and threats to sheep identified in order to develop the small ruminants' production and marketing. Potential interventions that were identified based on the constraints should be implemented and applied along the entire value chain in order to bring about the positive change in small ruminants' sectors in the study area.

**Authors contributions statement:** The authors confirm contribution to the paper as follows: study conception and design: R. Awad, A. Mohamed-Brahmi, A. Gasmi-Boubaker; data collection: Rula Awad; analysis and interpretation of results: R. Awad, A. Mohamed-Brahmi, H. Titi, M. Jaouad; draft manuscript preparation: R. Awad, A. Mohamed-Brahmi. All authors reviewed the results and approved the final version of the manuscript.

**Conflict of interest:** The authors declare no conflict of interest.

**Ethical statement:** This article does not contain any studies regarding human or Animal.

**Availability of data and material:** We declare that the submitted manuscript is our work, which has not been published before and is not currently being considered for publication elsewhere?

**Code availability:** Not applicable.

**Consent to participate:** All authors participated in this research study.

**Consent for publication:** All authors submitted consent to publish this research.

## REFERENCES

- Abu-Zanat, M., H. Miqdady and M. Tabb'a. 2005. Production systems of small ruminants in the Middle Badia of Jordan. *Dirasat, Agricultural Sciences* 32:205-214
- Alary V., Boutonnet J. and C. Dutilly-Diane. 2009. Chain analysis for small ruminant production- An overview of the livestock sector and case study in Maghreb. In: *FAO Regional Workshop on Improvement of Sustainable in the Near East*. Tunisia. pp. 17
- Al-Assaf, A. 2012. Economic implications of small ruminant diseases in the Northern Area of Jordan. *Journal of Food, Agriculture & Environment* 10:323-326
- Al-Khaza'leh, J., A. Abdelqader, M. Abuajamieh and F. Hayajneh. 2020. Assessment of water source availability and quality for small ruminant consumption in the Northern Badia region of Jordan. *Veterinary World*. 13: 1073- 1082. EISSN: 2231-0916 Available at [www.veterinaryworld.org/Vol.13/June-2020/9.pdf](http://www.veterinaryworld.org/Vol.13/June-2020/9.pdf)
- Allison, R., G. James, L. Grove, D. Higgitt, A. Kirk, N. Rosser and J. Warburton. 2000. Geomorphology of the Eastern Badia Basalt Plateau, Jordan. *The Geographical Journal* 166:352-70. <http://www.jstor.org/stable/823036>.
- AlNajjar K., A. Al-Momani, A. Al-Yacoub and R. Elsaid. 2021. Evaluation of Some Productive Characteristics of Jordanian Awassi. *International Journal of Livestock Research* 11:1-6. <https://dx.doi.org/10.5455/ijlr.20201220013326>
- Amankwah K., L. Klerkx, S.J. Oosting, O. Sakyi-Dawson, A.J. van der Zijpp and D. Millar. 2012. Diagnosing Constraints to Market Participation of Small Ruminant Producers in Northern Ghana: An Innovation Systems Analysis. *NJAS- Wageningen Journal of Life Sciences* 60-63:37-47.
- Braam, D. 2022. Excluding Livestock Livelihoods in Refugee Responses: A Risk to Public Health, *Journal of Refugee Studies* 35:910-928, <https://doi.org/10.1093/jrs/feac006>
- Berihulay, H., A. Abied, X. He, L., Jiang and Y. Ma. 2019. Adaptation mechanisms of small ruminants to environmental heat stress. *Animals* 9:75. <https://doi.org/10.3390/ani9030075>
- Care and IMMAP, 2018. Wheat and small ruminants market systems in Al-Hasakeh Governorate. Technical Report. Syria. Pp. 30
- Chakraborty M. and D. Gupta. 2017. Small Ruminant Value Chain in India: Opportunities and Constraints. *Indian Journal of Economics and Development* 5:1-5
- CNFA, 2016. Resilience and economic growth in the Sahel – Accelerated Growth (REGIS-AG) value chain and end market assessment: small ruminants. USAID: AID-625-C-14-00001. 74p. Available from internet:<URL: <https://api.semanticscholar.org/CorpusID:221668986> >
- Desalegn, Sh. 2020. Small Ruminant Value Chain Analysis in Fentale Districts of East Shoa Zone, Ethiopia. *American Journal of Modern Energy* 6:1-8. (Abst)
- Dube, S., I. Chakoma, and S. Bahta. 2017. Analysis of the goat value chain in Beitbridge district of Zimbabwe. ILRI Project Report.
- Duguma G., K. Degefa, T. Jembere, W. Temesgen, A. Haile and G. Legese. 2012. Value chain analysis of sheep in Horro district of Oromia region, Ethiopia: International Livestock Research Institute. Pp. 45
- Gebregziabhear, A. 2018. Analysis of sheep value chain: The case of Adama District, East Shoa of Oromia Regional State, Ethiopia. *Industrial Engineering Letters* 8:66-78
- Hosri, Ch., E. Tabet and M. Nehme. Goat and sheep products value chain analysis in Lebanon. In Napoléone M. (ed.), Ben Salem H. (ed.), Boutonnet J. P. (ed.), López-Francos A. (ed.), Gabiña D. (ed.). *The value chains of Mediterranean sheep and goat product. Organization of the industry, marketing strategies,*



- feeding and production systems. Zaragoza: CIHEAM, 2016. (Options Méditerranéennes : Série A. Séminaires Méditerranéennes 15:61-66
- Hussen, N., S. Kumsa, A. Haile, K. Hikuepi, and G. Legese. 2013. Analysis of goat value chain in Yabello District, Broana Zone, Ethiopia. Addis Ababa. ICARDA. Pp. 50
- Ibrahim, A., G. Budisatria, R. Widayanti and W. Artama. 2019. The impact of religious festival on roadside livestock traders in urban and peri-urban areas of Yogyakarta, Indonesia. *Vet World* 12:1408-1415.
- Ibrahim, Kh., I. Rabba' and Kh. Tarawneh. 2001. Geological and Mineral Occurrences Map of the Northern Badia, Jordan Scale 1:250,000. Geological Mapping Division. Jordan. Pp. 136
- ILRI, CIAT, ICARDA, et al. 2011. Sheep and goat meat value chain in Mali: Background proposals for the CGIAR research program on livestock and fish. More meat, milk, and fish by and for the Poor (CGIAR Research Program 3.7): A proposal submitted to the CGIAR Consortium Board by ILRI on behalf of CIAT, ICARDA and WorldFish Centre. Nairobi, Kenya: ILRI. 12p
- Ilukor, J., J. Mudiope, H. Desire and H. Mwololo. 2020. Market and value chain analysis to support development response to displacement impacts project investments in Adjumani District in Uganda. Technical Report. World Bank Group. Uganda. Pp. 154
- Istaitih, Y., and M. Mencet Yelboga. 2018. SWOT analysis of small ruminant production in West Bank- Palestine. *Mediterranean Agricultural Sciences*. 31:255-259
- Joy, A., FR. Dunshea, BJ. Leury, IJ. Clarke, K. DiGiacomo and SS. Chauhan. 2020. Resilience of small ruminants to climate change and increased environmental temperature: A review. *Animals (Basel)*. 10:867.
- Juniedi, J., and M. Abu-Zanat. 1993. Jordan agricultural sector review: Low rainfall zone. Technical Report No. 132, Volume 1. Agricultural Policy Analysis Project, Phase II (APAP II) and USAID/Amman
- Kassahun, Y., M. Ketema, and Z. Shumeta. 2020. Determinants of participation decision and levels of participation in small ruminants market. *Sustainable Agriculture Research* 9:56-66.
- Khader, A. 2013. Preparing research and scientific theses from idea to conclusion. Faculty of Education, Al-Azhar University, Cairo (in Arabic)
- Kumar, S. and M. Roy. 2013. Small ruminant's role in sustaining rural livelihoods in arid and semiarid regions and their potential for commercialization. *New Paradigms in livestock production from traditional to commercial farming and beyond* (Eds) Shiv Prasad et al. 2013. Agrotech publishing academy, Udaipur, pp. 57-80
- Katiku, P., R. K. Kimitei, B. K. Korir, T. K. Muasya, J. M. Chengole, B. P. Ogillo, J. W. Munyasi and S. K. Karimi. 2013. Value chain assessment of small ruminant production, challenges and opportunities: The case of Southern Rangelands of Kenya. *Livestock Research for Rural Development* 25:14
- Legese, G., A. Haile, A. Duncan, T. Dessie, S. Gizaw, and B. Rischkowsky. 2014. Sheep and goat value chains in Ethiopia: A synthesis of opportunities and constraints. ILRI (aka ILCA and ILRAD).
- MercyCorps, 2014. Small ruminant dairy value chain assessment. Lebanon. 30p. Available from internet: URL: <https://www.mercycorps.org/sites/default/files/202001/FINAL%20Mercy%20Corps%20Lebanon%20Small%20Ruminant%20Dairy%20Value%20Chain.pdf>
- MKSP, 2016. Study on value chain of small ruminants and poultry birds in MKSP area in Pottangi and Semiliguda blocks of Odisha. Lavosdisha.org. India. Technical Report available from internet: [https://lavsodisha.org/downloads/Study\\_On\\_Small\\_Ruminants\\_and\\_Poultry\\_Value\\_Chain.pdf](https://lavsodisha.org/downloads/Study_On_Small_Ruminants_and_Poultry_Value_Chain.pdf). pp.68
- Ministry of Agriculture of Jordan. 2021. Unpublished Statistic. Jordan
- Namonje-Kapembwa, Th., H. Chiwawa, and N. Sitko. 2019. Value chain analysis of goats in Zambia: Challenges and opportunities of linking smallholders to markets. *AgEcon Search*. Research paper pp. 39. 42.
- Sahoo, A., D. Kumar, and S. Naqvi. 2013. Strategies for sustaining small ruminant production in arid and semi-arid regions. P-20-34. In. A. Sahoo, D. Kumar and S. Naqvi (eds). *Climate resilient small ruminant production*. NCRA. India
- Salahat, M. and M. Al-Qinna. 2015. Rainfall fluctuation for exploring desertification and climate change: new aridity classification. *Jordan Journal of Earth and Environmental Sciences* 7: 27-35
- Scott, D. and N. Dunstone. 2000. Environmental determinants of the composition of desert-living rodent communities in the north-east Badia region of Jordan. *Journal of Zoology* 251:481-494
- Sejien, V., J. Ravindra and C. Prasad. 2013. Livestock Production under Ensuring Climate Change Scenario: Resilience versus Performance. P. 8-19. In. A. Sahoo, D. Kumar and S. Naqvi (eds). *Climate Resilient Small Ruminant Production*. NCRA. India.
- Shah, H., W. Akhtar, N. Akmal, T. Hassan, W. Farooq, M. Islam, G. T. Kassie, B. Rischkowsky and A. Razzaq. Rapid Assessment of the Small Ruminant Value Chain in Chakwal District, Pakistan. [on line]. Islamabad (Pakistan): ICARDA, 2015a, 48 p. Technical Report available from internet: <URL:<https://www.researchgate.net/publication/322499918>>
- Shah, H., W. Akhtar, N. Akmal, M. A. Khan, W. Farooq, M. Islam, G. T. Kassie, B. Rischkowsky and A. Razzaq. Rapid Assessment of the Small Ruminant Value Chain in District Bahawalpur, Pakistan. [on line]. Islamabad (Pakistan): ICARDA, 2015b, 43 p. Technical Report





- available from internet: <URL:  
[https://www.researchgate.net/publication/322500171\\_Rapid\\_Assessment\\_of\\_the\\_Small\\_Ruminant\\_Value\\_Chain\\_in\\_District\\_Bahawalpur\\_Pakistan](https://www.researchgate.net/publication/322500171_Rapid_Assessment_of_the_Small_Ruminant_Value_Chain_in_District_Bahawalpur_Pakistan)>
- Shwaqfeh, K. 2006. The geography of poverty in Um-Aljema sub-district and Al-Ruweished District. Unpublished Master Thesis. Jordan University
- Tabbaa, M., F. Barakeh, M. Baker. 2018. Production systems of small ruminants in the Abu-Dhabi Emirate, UAE. *Journal of Experimental Biology and Agricultural Sciences*, 6(5), 816 – 827
- Touray, O. 2017. Review of the livestock/ Meat and milk value chains and policy influencing them in Liberia. FAO and ECOWAS. I5270EN/1/05.17. 43.
- Wadhwani, K., R. Modi, M. Islam, and Y. Patel. 2016. Role of housing in welfare of small ruminants. *Indian Journal of Animal Production and Management* 32:130-139.
- Wilson, T. 1989. Reproductive performance of African indigenous small ruminants under various management systems: A review. *Anim. Reproduction Sciences* 20:265-286 (Abstr)

